

AD-A234

131

Report to the Chairman, Committee on
Armed Services, House of
Representatives

March 1991

UNMANNED AERIAL VEHICLES

Medium Range System Components Do Not Fit



United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-242779

March 25, 1991

The Honorable Les Aspin
Chairman, Committee on
Armed Services
House of Representatives

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Dear Mr. Chairman:

As you requested, we reviewed the status of the joint-service Medium-Range Unmanned Aerial Vehicle (UAV) program. Because the success of this program depends on the Advanced Tactical Air Reconnaissance System (ATARS) and the Joint Service Imagery Processing System, we also reviewed aspects of those programs which affected the Medium-Range UAV program.

As agreed with your staff, this is an interim report addressing one of several major problems currently affecting the Medium-Range UAV program: the payload does not fit in the vehicle. The other problems are briefly described in this report and will be developed in a follow-up assignment.

Background

The Medium-Range UAV program is a joint effort by the Navy and Air Force and is managed by the UAV Joint Program Office. However, ATARS, the payload for the Medium-Range UAV, is managed by the Air Force. This system is supposed to be a common-service payload for use on unmanned as well as manned aircraft. Similarly, the ground station for the Medium-Range UAV, called the Joint Service Imagery Processing System, is also managed by the Air Force and is to be used by the services for near real-time processing of imagery from UAVs, manned reconnaissance aircraft, and national assets.

The Medium-Range UAV is required to be capable of air launch from specially modified fighter or attack aircraft such as the Air Force's F-16 and the Navy/Marine Corps F/A-18. A mobile ground launcher is also being developed for the Air Force.

The Department of Defense (DOD) is acquiring UAVs to perform military missions such as reconnaissance or surveillance of enemy activities and identification of targets. UAV systems typically include an air vehicle, a

launch and recovery system, and a ground station for processing information from the UAV. The type of payload the UAV carries, such as a television camera or infrared sensor, depends on the military mission.

For several years, congressional committees expressed concern about the duplication in service UAV programs and the need to acquire UAVs that could meet the requirements of more than one service. Then, in the fiscal year 1988 budget proceedings, the Congress eliminated funding in the services' separate accounts and consolidated service efforts in a joint program.

Full-scale development of the Medium-Range UAV began in June 1989. This effort was expected to cost about \$200 million but is now expected to exceed \$300 million because of recently encountered technical problems and other factors. The UAV's procurement cost was recently estimated to be about \$700 million for production of 237 UAVs and ATARS payloads during fiscal years 1993 through 1997. DOD has not estimated the cost to complete the total program buy of 525 UAVs and ATARS payloads. The cost of the Joint Service Imagery Processing System is classified.

Results in Brief

DOD has encountered a major problem in developing the Medium-Range UAV for common-service use because the ATARS payload will not fit in the UAV. If this problem is not satisfactorily solved, it could undermine the program goals of having a common-service UAV, reconnaissance payload, and imagery processing system for UAVs and manned aircraft. → (ver.)

The Navy contracted for development of an alternative payload that does fit in the UAV and has a contractual option to buy more. This alternative payload, which the Air Force maintains will not meet its requirements, is not compatible with the Joint Services Imagery Processing System and thus would require its own ground station for processing reconnaissance information from the UAV. The Navy's procurement of the alternative payload as a substitute for ATARS would defeat the goals and economies of a common-service UAV and imagery processing system. Navy officials maintain the alternative payload will only be used for testing.

The fit problem resulted from the Air Force's failure to coordinate adequately with the Medium-Range UAV Program Office and control the size of the reconnaissance payload being developed by its contractor. -

→ In addition to the payload fit problem, Medium-Range UAV program officials informed us that the program has encountered several other problems.

- The UAV airframe's substructure of aluminum honeycomb lattice could deteriorate rapidly in a saltwater environment and allow delamination of the outer composite skin. Because the delamination would be difficult or impossible to detect, Navy officials consider such an airframe design unsafe to carry on manned aircraft.
- The UAV's design could cause it to lift and crash into its launching F/A-18 during an emergency UAV jettison if the aircraft's nose is up at the time.
- The plan for ocean recovery provides that the UAV float in the ocean until recovered. This raises the risk of water and corrosion damage to the ATARS payload and other UAV components. DOD has not determined whether this level of risk is unacceptable. However, the Navy prefers a system whereby the UAV would be retrieved in mid-air by a helicopter.
- The UAV's navigation system may have insufficient accuracy for identifying the location of targets.
- The UAV's planned identification friend-or-foe system does not ensure that friendly forces could distinguish it from enemy aircraft. This could cause friendly forces to engage it with air defense weapons.
- The UAV's cooling system may be inadequate for the ATARS payload. Overheating could occur during simultaneous operation of the videotape recorder filming the mission and the datalink transmitting the imagery back to the Joint Services Imagery Processing System. DOD believes that this condition is not likely to occur. However, the program manager is proposing a design change which will solve this and other problems.
- The configuration of Navy aircraft carriers allows insufficient space for a manual control station for remotely piloted operation of the UAV. Hence, preprogrammed flight and recovery plans cannot be modified after launch as required.

To solve the problems, the Medium-Range UAV Program Manager is proposing numerous changes that, when taken together, would represent a vastly different UAV. The new UAV would include a larger payload bay to accommodate ATARS and would incorporate various other features to solve the current system's existing problems. ✕

Recommendations

We recommend that the Secretary of Defense

- ensure that the solution to the payload fit problem preserves the commonality goals of the Medium-Range UAV, ATARS, and Joint Services Imagery Processing System programs and
- require the services to obtain advance written concurrence or nonconcurrency for proposed changes in separately developed interrelated programs from program offices to ensure that integration problems such as the Medium Range UAV/ATARS fit problem do not occur in future programs.

Matter for Congressional Consideration

The opportunity to achieve a common-service UAV, a common-service payload for use on both UAVs and manned aircraft, and a common-service imagery processing system for UAVs, manned aircraft, and national assets could all be lost if DOD does not satisfactorily resolve the fit problem. Thus, the Congress should closely monitor DOD's efforts to solve the problem and oppose any funding requests which do not preserve commonality goals.

Agency Comments and Our Evaluation

DOD agreed or partially agreed with our findings but noted that even if the fit problem had not occurred, the program would have had to be restructured to resolve the other problems discussed in this report. DOD also agreed with one recommendation and the matter for congressional consideration. However, DOD disagreed with our recommendation that the Secretary of Defense require the services to obtain advance written concurrence for changes in separately developed interrelated programs.

DOD stated that it has a mechanism in the acquisition process to ensure changes in a subsystem in one program are coordinated with other related programs. DOD said that this coordination is done through configuration control boards, an internal part of the acquisition process, and that another procedure is not needed.

We note, however, that DOD's configuration control board procedures did not ensure that adequate coordination occurred between the ATARS program and the Medium-Range UAV program. The Medium-Range UAV Program Manager was not a member of the configuration control board for ATARS, although the Medium-Range UAV and ATARS are interdependent programs. Despite the payload fit problem, the Medium-Range Program Manager or his designated representative is still not a member of the ATARS configuration control board.

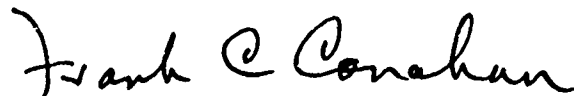
We continue to believe that DOD needs to implement a procedure that would preclude problems such as the Air Force increasing the size of the ATARS payload without the knowledge or consent of the Medium-Range Program Manager. Since configuration control board procedures call for written recommendations of approval or disapproval for proposed changes, the Secretary of Defense could implement our recommendation by changing configuration control board procedures to specifically require that program managers of interrelated programs or their designees be represented on configuration control boards.

Appendix I discusses the status of the Medium-Range UAV program in more detail. Appendix II describes our objective, scope, and methodology. Appendix III contains DOD comments and our response.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 10 days from its issue. At that time, we will send copies to other interested congressional committees; the Secretaries of Defense and the Air Force and Navy; the Director, Office of Management and Budget; and other interested parties. We will make copies available to others upon request.

This report was prepared under the direction of Louis J. Rodrigues, Director, Command, Control, Communications, and Intelligence Issues, who may be reached on (202) 275-4841 if you or your staff have any questions. Other major contributors are listed in appendix IV.

Sincerely yours,



Frank C. Conahan
Assistant Comptroller General

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Abbreviations

| | |
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| GAO | General Accounting Office |
| DOD | Department of Defense |
| UAV | Unmanned Aerial Vehicle |
| ATARS | Advanced Tactical Air Reconnaissance System |

Status of DOD's Medium-Range UAV Development Effort

Background

As part of its Joint Unmanned Aerial Vehicle (UAV) program, the Department of Defense (DOD) is developing the Medium-Range UAV System to provide unmanned tactical reconnaissance capability for the Air Force, Navy, and Marine Corps. The system is to provide the capability to perform reconnaissance, target assessment, battle damage assessment, and other military missions. It is to be one in a family of planned UAV systems to include the Endurance, Close Range, and Short Range UAVs. (See fig. I.1.)

UAVs are pilotless aircraft that are remotely controlled from ground or shipboard stations or preprogrammed to fly a designated flight plan. A UAV system typically includes an air vehicle, a payload, such as a television camera, and a ground station for controlling the vehicle and processing information from the UAV.

Figure I.1: Medium-Range UAV Prototype in Flight



Source: Teledyne-Ryan Aeronautical

The Medium-Range UAV represents the unmanned portions of the Navy and Marine Corps Tactical Air Reconnaissance System and the Air Force Follow-On Tactical Air Reconnaissance System. These systems are to replace current film-based manned reconnaissance systems with the latest electro-optical and digital systems for both manned and unmanned aircraft.

Medium-Range UAV platforms will augment reconnaissance versions of manned aircraft, such as the F/A-18 and F-16, currently being planned by the Navy and Air Force. For example, if a wing commander believes that a reconnaissance mission is too dangerous for a manned aircraft or could risk capture of a pilot, the commander could dispatch a UAV.

Both the manned and unmanned aircraft are intended to carry versions of a common-service payload known as the Advanced Tactical Air Reconnaissance System (ATARS) for gathering and transmitting imagery data. They will also use a common ground station called the Joint Services Imagery Processing System for receiving and processing imagery data they record.

The Medium-Range UAV is required to be capable of air launch from specially modified fighter or attack aircraft such as the Air Force's F-16 and the Navy/Marine Corps' F/A-18. A mobile ground launcher is also being developed for the Air Force.

Medium-Range UAV Program Management

Development of the Medium-Range UAV System is a cooperative effort of the Navy and Air Force which began in 1987. The full-scale development contract was awarded in June 1989. DOD's UAV Joint Program Office, established in 1988 as an element of the Naval Air Systems Command, manages the program. The Joint Program Office was formed in response to congressional concern about duplication in service UAV programs and the need to acquire UAVs that could meet the needs of more than one service.

By agreement with the Navy in 1985 and the Joint Program Office, the Air Force is responsible for developing the ATARS sensor payload for the Medium-Range UAV platform, Navy/Marine Corps F/A-18, and Air Force F-16 manned aircraft. The ATARS program office is located within the Aeronautical Systems Division of the Air Force Systems Command.

The Air Force is also responsible for development of the Joint Services Imagery Processing System common ground station for use with manned aircraft, UAVs, and national assets. This system is to receive transmitted images on the ground from various sensors, including ATARS in near real-time.

Medium-Range UAV System Cost

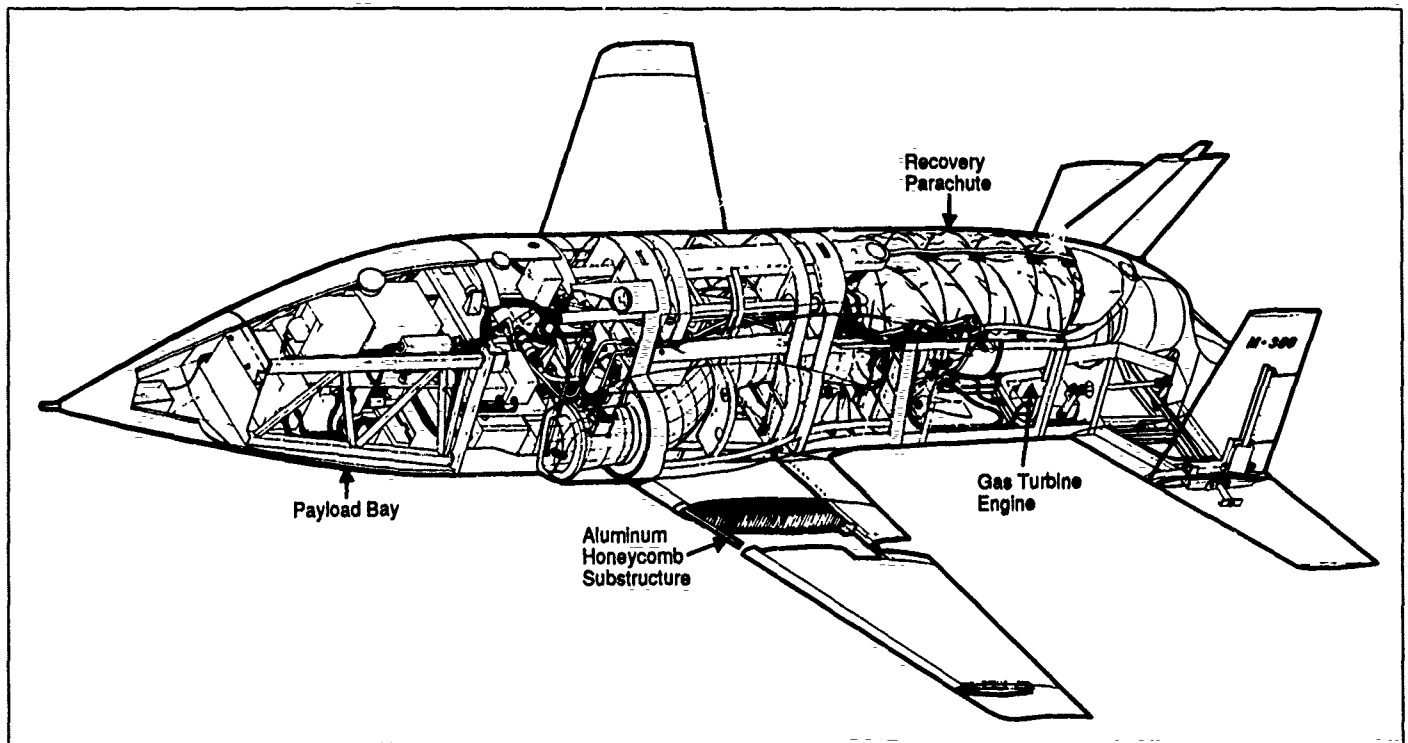
Research, development, test, and evaluation of the Medium-Range UAV was estimated to cost about \$200 million. However, Medium-Range UAV officials said that this estimate will increase by over \$100 million because of recently encountered technical problems and other factors. The procurement cost was recently estimated to be about \$700 million for production of 237 UAVs and ATARS payloads during fiscal years 1993

through 1997. DOD has not estimate³ the cost to complete the total program buy of 525 UAVs and ATARS payloads. The cost of the Joint Services Imagery Processing System is classified.

ATARS Components Will Not Fit in UAV

A major problem has been discovered in the development and integration effort of the Air Force's ATARS sensor payload for the Medium-Range UAV. ATARS in its present configuration does not fit in the UAV's payload bay. (See fig. I.2.) If not satisfactorily solved, this problem could undermine the common-service goals of the Medium-Range UAV, the ATARS, and the Joint Services Imagery Processing System programs.

Figure I.2: Medium-Range UAV Design



Source: Teledyne-Ryan Aeronautical

Navy-Unique UAV Could Result

Failure to satisfactorily solve the payload fit problem could result in a UAV unique to the Navy. The Medium-Range UAV contract contains a provision for developing an alternative sensor to the ATARS payload for the Medium-Range UAV. This sensor is referred to as an "interim" or "test and evaluation" payload and would be less capable and less costly than

ATARS. The contract also contains production options for the alternative sensor.

Based on our comparison of the requirements document for the alternative payload and Air Force requirements for ATARS, the alternative payload meets Navy requirements but will not meet Air Force requirements. In addition, the alternative payload would not be capable of operating with the Joint Services Imagery Processing System. Thus, if the Navy were to select the alternative payload, it would have to acquire another ground station. Procuring the alternative sensor would defeat the congressional and DOD goals of having a common-service UAV, payload, and imagery processing system. Navy officials maintain the alternative payload will only be used for testing.

ATARS for UAVs and Manned Aircraft Could Differ

The Air Force has continued developing the ATARS payload for manned aircraft while the fit problem with UAVs remains unresolved. It also rejected proposals by the ATARS contractor to develop a smaller ATARS variant capable of fitting in the UAV, because the variants would not have adequate performance capability or would cost too much.

Air Force officials said they will now rely on the UAV Program Office to solve the fit problem and will not develop an ATARS variant for UAVs. However, if the ATARS fit problem is not solved, the Air Force will have to consider an alternative payload, which would defeat the goal of having one reconnaissance payload for manned aircraft and UAVs.

Air Force Failed to Coordinate With UAV Office and Control Payload Size

The fit problem resulted from the Air Force's failure to coordinate adequately with the UAV Program Office and control the size of the ATARS payload during the development process.

Recognizing that the ATARS payload would be carried in the Medium-Range UAV, the Air Force provided the UAV Program Office with preliminary ATARS specifications describing the projected size and weight of the payload. In September 1988, the UAV Program Office provided these ATARS specifications to the potential UAV contractors at its bidders conference and stipulated that the UAV must be capable of carrying the ATARS payload.

In January 1989, while evaluating the contractors' proposals for carrying ATARS as specified, the Medium-Range UAV Source Selection Board determined that one bidder, Teledyne-Ryan Aeronautical, would have to

increase the payload bay length of its existing UAV by 20 inches to accommodate the payload. In April 1989, Teledyne agreed to do so and on June 30, 1989, was awarded the Medium-Range UAV contract.

However, in May 1989, before the UAV contract award, the Air Force approved changes to the ATARS specifications. At that time, the subcontractor for the videotape recorder component of ATARS, with the knowledge and approval of the Air Force and its prime contractor, revised the September 1988 recorder specification the Air Force had provided to the UAV Program Office. The revised specification divided the ATARS recorder into two components that were individually lighter than the single component recorder but were larger and heavier overall.

The September 1988 specification described the recorder size as one box measuring 19 x 11 x 14 inches and weighing 60 pounds. The new specifications described two boxes, one measuring 14.3 x 11.4 x 13.5 inches and weighing 41 pounds, and another measuring 13.8 x 8.6 x 13.5 inches and weighing 38.5 pounds. According to Air Force officials, dividing the recorder into two lighter components was dictated by a military standard which requires that equipment to be lifted by military personnel weigh no more than 37 pounds.

According to Medium-Range UAV officials, they were not consulted prior to the change in the specifications. Air Force officials said the recorder change was coordinated with a Navy official responsible for ATARS for manned aircraft, but that UAV officials were informed only after the change.

We asked Air Force officials why they approved the modification to ATARS without first coordinating with UAV officials and determining that the payload would still fit in the UAVs being considered. They said the recorder change did not create significant concern for the Air Force because UAV constraints and design flexibility were not known to them at the time.

Subsequently, on July 27, 1989, during a coordination meeting with Medium-Range UAV officials, Air Force ATARS officials, the ATARS contractor, and the newly selected UAV contractor, the specifications for the Air Force-approved revised payload were provided by the ATARS contractor. From the revised specifications, which included the larger two box videotape recorder, UAV program officials learned that ATARS would no longer fit in the Medium-Range UAV's payload bay despite the proposed 20-inch extension.

Medium-Range UAV Has Several Other Problems

In addition to the payload fit problem, Medium-Range UAV program officials informed us that the program has encountered several other serious problems.

UAV Material Structure Can Become Unsafe

The current UAV design includes a substructure of an aluminum honeycomb lattice. The honeycomb is covered by a graphite-epoxy composite material. This type of design is used in a number of military aircraft because it weighs less than the more conventional substructure of steel or aluminum ribs covered by aluminum sheet metal.

Navy structural experts have determined that the aluminum honeycomb will deteriorate rapidly if it comes in contact with saltwater. The outer composite material could protect the aluminum honeycomb if it remains undamaged and intact. But maintenance experience with other military aircraft indicates that there is no means of adequately ensuring that the outer composite material will not be penetrated.

UAV program and Navy officials are concerned that delamination of the composite skin after corrosion of the honeycomb would be difficult or impossible to detect. If undetected delamination were to occur, the UAV could come apart while attached to the launch aircraft. Hence, UAV and Navy officials now consider such a UAV airframe design unsafe to carry on or launch from manned aircraft.

UAV Design Could Cause Crashes of Launching Aircraft

Assuming that the UAV does not come apart while being carried by the F/A-18, according to DOD officials, it would still be considered unsafe for carrying on the aircraft. According to Medium-Range UAV program officials, the UAV's design could cause it to lift and crash into its launching F/A-18 during an emergency UAV jettison if the aircraft's nose is up at the time, such as directly after catapult launch from an aircraft carrier. (See fig. I.3.)

In this case the UAV may not fall down and away from the aircraft when released but may actually climb and strike the launch aircraft's wings or fuselage. Wind tunnel tests are scheduled for February 1991 to confirm or disprove that this is a problem.

**Ocean Recovery System
May Be Inadequate**

The UAV recovery system provides that when returning from a mission at sea, the vehicle will fly to the vicinity of the aircraft carrier and descend by parachute. A helicopter or ship would then recover the UAV after it lands in the ocean. However, the Navy has now determined that the possibility of water and corrosion damage to the ATARS payload and other UAV components requires changing the recovery system. Although DOD has not determined that the risk of water and corrosion damage is unacceptable, the Navy prefers a system whereby the UAV would be retrieved in mid-air by a helicopter.

**Commercial Navigation
System May Be Inadequate**

The UAV's navigation system includes use of the commercial version of the Global Positioning System to achieve required accuracy. System specifications require that the UAV be able to overfly a target of known location at a distance of at least 350 nautical miles from the UAV launch point. However, the Program Office has now decided that commercial Global Positioning System capability may be insufficient for the UAV to achieve the accuracy necessary to successfully identify the location of targets.

According to DOD, this condition could occur if commercial Global Positioning System signals were degraded for national security reasons. This potential problem could be overcome by replacing the commercial Global Positioning System receiver with the more expensive military version.

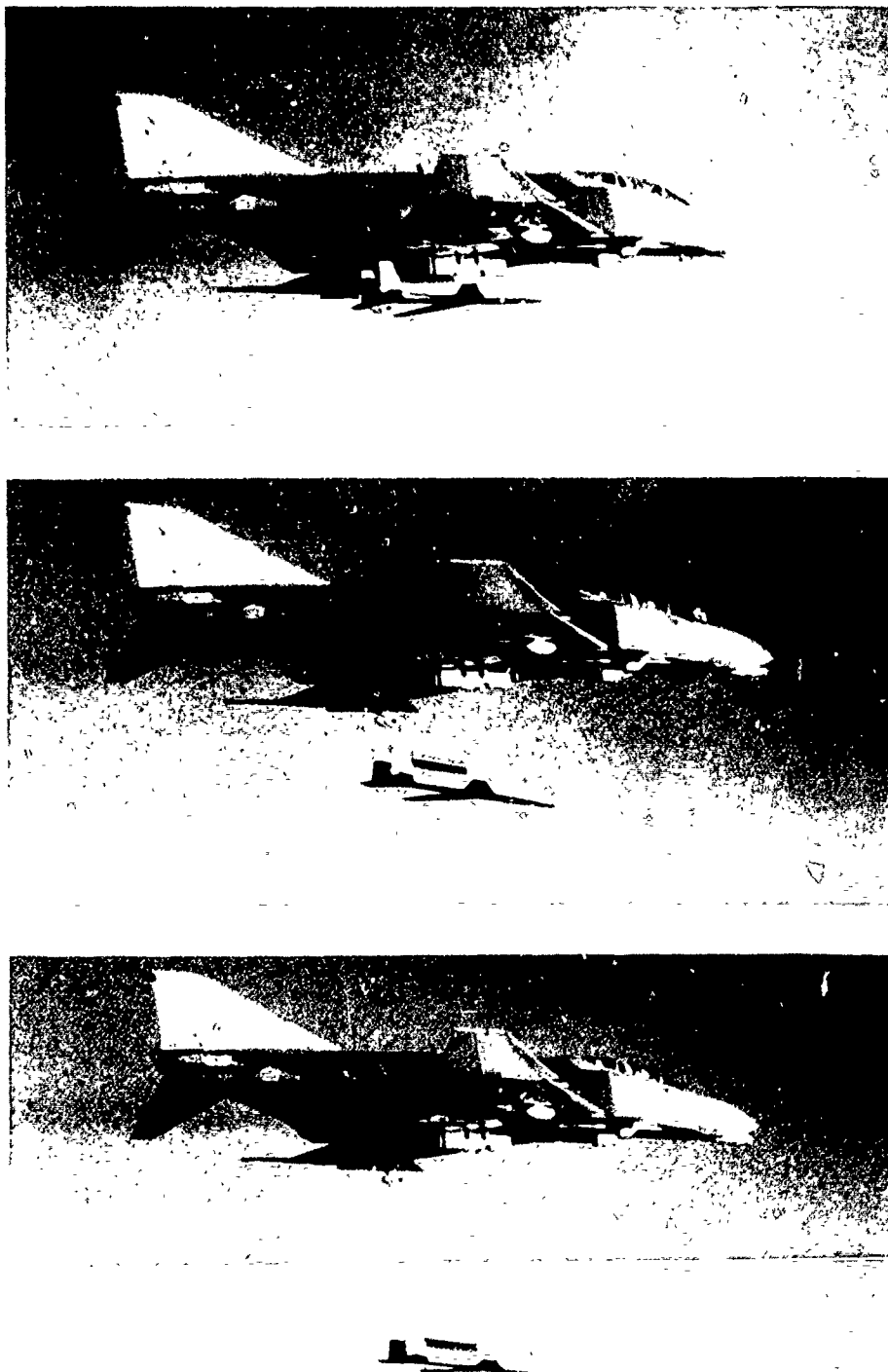
**UAV Is Susceptible to
Friendly Weapons**

Other than visual recognition, the UAV's planned identification friend-or-foe system provides no effective way for friendly forces to distinguish it from threat aircraft. Thus, the UAV would be susceptible to engagement by friendly air defense weapons at beyond visual ranges.

**Cooling System May Be
Inadequate**

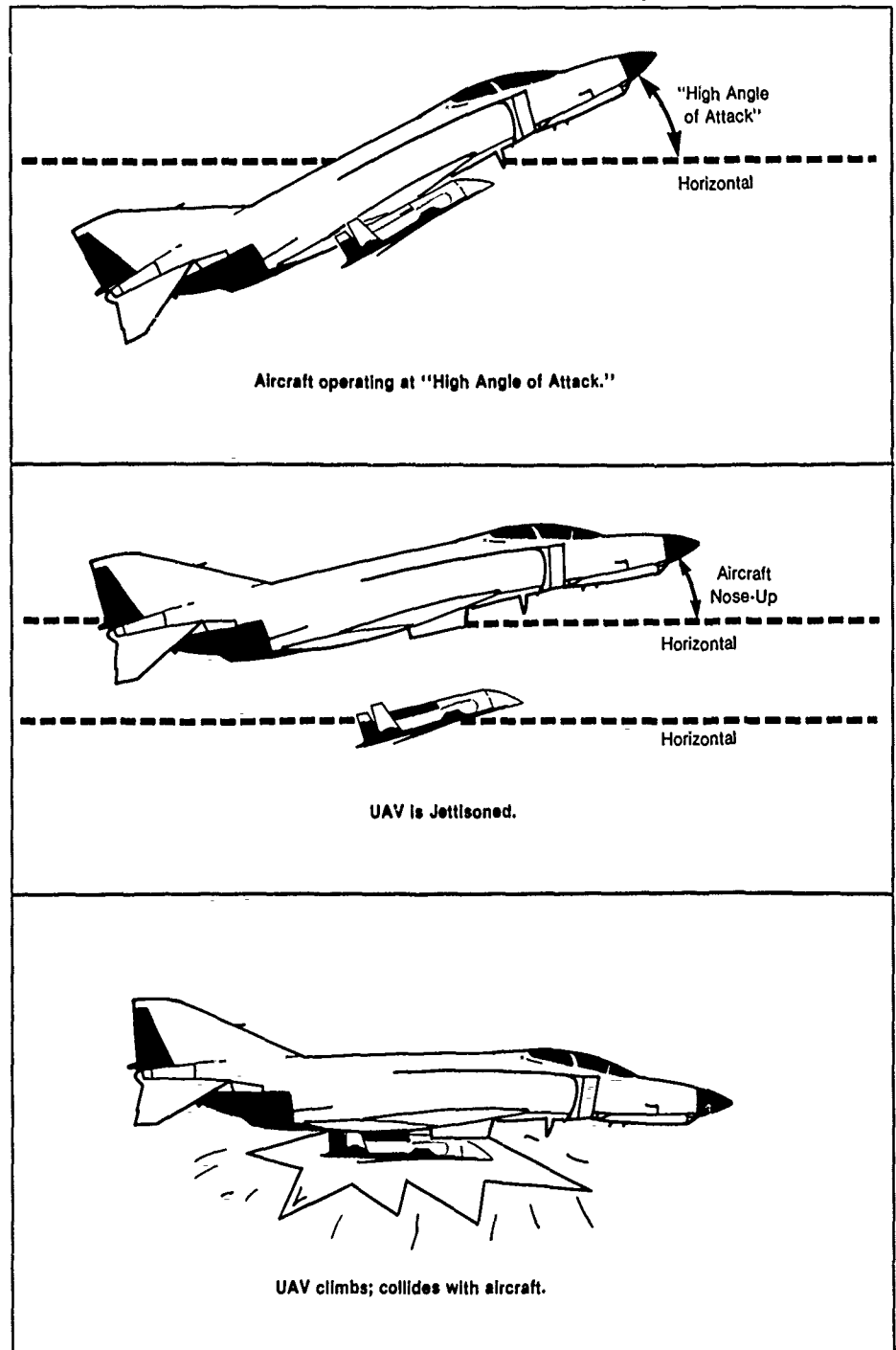
The ATARS payload does not have a cooling capability. Instead, the payload is to be cooled by the UAV's environmental control system. However, the UAV's cooling system may be inadequate for the ATARS payload during some environmental conditions. Overheating could occur during simultaneous operation of the videotape recorder filming the mission and the datalink transmitting the imagery back to the Joint Services Imagery Processing System. One computer analysis indicates that payload overheating could occur after just 12 minutes of operation, while total recording time for a typical mission could be about 45 minutes.

Figure I.3: Medium Range UAV Normal
Launch Sequence and Possible Hazard
of Emergency Jettison



Source: Teledyne-Ryan Aeronautical

Figure I.3: Medium Range UAV Normal
Launch Sequence and Possible Hazard
of Emergency Jettison (cont'd)



GAO Artist's Rendering

DOD contends that the overheating problem is not likely to occur and that testing is required to determine whether a deficiency exists. However, the Medium Range UAV Program Manager is proposing a design change that will solve this and other problems. To maintain the required operational range of the larger aluminum UAV, a larger fuel tank is required. This will provide more cooling because fuel is the medium for heat exchange in cooling the payload.

UAV Control Station Is Too Large for Navy Aircraft Carriers

The UAV system specifications include a manual control station on board ship that is supposed to allow for remote operation of the UAV's flight whenever it is in datalink range or within the line of sight of the control station. Such control of the UAV's flight was desired to transmit course corrections and was expected to facilitate recovery operations during the latter stages of a mission. However, the space on Navy aircraft carriers that could be allotted for UAV operations is too small for the ground control station. Hence, preprogrammed flight and recovery plans cannot be modified after launch as required.

Program Manager Proposes Vastly Different UAV

To solve the payload fit and other problems, the Medium-Range UAV Program Manager is proposing major changes that when taken together represent a vastly different UAV. The new UAV would incorporate a larger payload compartment, aluminum sheet metal in place of composite material, elimination of the honeycomb substructure, addition of the mid-air retrieval system and a different friend or foe identification system, possible addition of the military Global Positioning System, improvements for the cooling system, and elimination of the remotely piloted requirement. The Program Manager's proposal is awaiting approval by the UAV Executive Committee.

Objective, Scope, and Methodology

In response to a request from the Chairman, House Committee on Armed Services, we reviewed the status of the Medium-Range UAV program. After our initial efforts disclosed that the ATARS payload would not fit in the Medium-Range UAV, we concentrated on determining why the problem occurred and assessing the implications of the services continuing affected programs without solving the problem. This required that we also review certain aspects of the ATARS and Joint Service Imagery Processing System programs.

After we completed field work on the fit problem and discussed our findings with the Medium-Range UAV Program Manager, he told us that he was proposing a restructured program under which a vastly different UAV would be developed to solve the fit problem as well as several other problems. We therefore extended our review to determine the nature of the additional problems. However, as agreed with the staff of the House Committee on Armed Services, determining the causes of these additional problems will be the subject of a follow-up assignment.

We performed our work primarily at the Medium-Range UAV Program Office in Washington, D.C.; the ATARS Program Office at Wright-Patterson Air Force Base, Ohio; and Joint Services Imagery Processing System Program Office at Hanscom Air Force Base, Massachusetts.

We interviewed Medium-Range UAV program and Air Force officials responsible for managing the programs to understand the circumstances and events that led to the fit problem and identify current plans for continuing the programs. We also reviewed contractor documents and other records bearing on the fit problem. In addition, we discussed the fit problem and efforts to solve it with representatives of the Medium-Range UAV and ATARS contractors.

We performed our review from October 1989 through October 1990 in accordance with generally accepted government auditing standards.

Comments From the Department of Defense

Note. GAO comments supplementing those in the report text appear at the end of this appendix.



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

12 FEB 1991

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) Draft Report, "UNMANNED AERIAL VEHICLE: Medium Range System Components Do Not Fit," dated December 10, 1990 (GAO Code 395148/OSD Case 8563). The DoD partially concurs with the findings and concurs with the recommendation to preserve commonality goals and the matter for congressional consideration. The DoD does not however, agree with the second recommendation to obtain advanced written concurrence for changes in interrelated programs. It is unnecessary because the DoD already has a mechanism in the acquisition process to ensure changes in a subsystem in one program are coordinated with other related programs. The Joint Program Office is taking steps to implement that mechanism for the Unmanned Medium-Range Aerial Vehicle.

The report correctly identifies several technical problems in the Medium-Range program. A program restructure was required to address (1) multiple technical problems, (2) required changes to meet operational requirements more effectively, and (3) funding redistributions and reductions.

Detailed DoD comments on the report findings, recommendations, and matter for congressional consideration are provided in the enclosure. Thank you for the opportunity to review and to comment on the draft report.

Sincerely,

H. Steven Kinnel
for Charles M. Herzfeld

Enclosure

GAO DRAFT REPORT - DATED DECEMBER 10, 1990
(GAO CODE 395148) OSD CASE 8563

**"UNMANNED AERIAL VEHICLE: MEDIUM RANGE SYSTEM
COMPONENTS DO NOT FIT**

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

- **FINDING A: Medium Range Unmanned Aerial Vehicle Program.**
The GAO reported that the Medium-Range Unmanned Aerial Vehicle Program is a joint effort by the Navy and Air Force managed by the Unmanned Aerial Vehicle Program Office, which was established in 1988 as an element of the Naval Air Systems Command. The GAO further reported that the payload, the Advanced Tactical Air Reconnaissance System, is managed by the Air Force as a common-Service payload--for use on unmanned aerial vehicles as well as manned aircraft. Similarly, the GAO found that the Joint Service Imagery Processing System, the ground station, is also managed by the Air Force for a number of users. The GAO observed that, for several years, congressional committees expressed concern about duplication and the need to acquire unmanned aerial vehicles to meet the requirements for more than one Service. The GAO further observed that, in FY 1988, the Congress eliminated funding in the separate Service budget accounts and, instead, consolidated Service efforts in a joint program.

The GAO reported that the Medium-Range Unmanned Aerial Vehicle is required to be capable of air launch from specially modified fighter or attack aircraft, and that a mobile ground launcher is being developed. The GAO found that full-scale development of the Medium-Range Unmanned Aerial Vehicle was expected to cost about \$200 million--but the cost is now expected to increase by as much as \$50 million because of technical problems. The GAO also found that the production cost for 237 vehicles and payloads through FY 1997 is estimated at about \$700 million, with costs to complete the total buy of 535 not yet estimated. (pp. 1-3, pp. 10-13/GAO Draft Report)

DOD RESPONSE: Concur. The full scale development cost of the Medium-Range Unmanned Aerial Vehicle is now estimated to exceed \$300 million because of (1) technical problems, (2) changes to meet operational requirements more effectively, and (3) DoD imposed redistributions and reductions to the program. January 1991 Program Office estimates are that those changes will delay the Initial Operational Capability of the system by at least two

Now on pp. 1-2, 8-11.

See comment 1.

years, and increase the full-scale development costs. However, several development/cost options presently are being evaluated by the Program Office for presentation to the Unmanned Aerial Vehicle Executive Committee in April 1991. At that time, the most cost-effective solution to meet Service requirements will be selected and the true cost of the Medium-Range program established.

- **FINDING B: Advanced Tactical Air Reconnaissance System Components Will Not Fit On Unmanned Aerial Vehicle.** The GAO observed that the DoD has encountered a major problem in developing the Medium-Range Unmanned Aerial Vehicle for common-Service use, because of the recent discovery that the Advanced Tactical Air Reconnaissance System will not fit in the unmanned aerial vehicle. The GAO found that the Navy contracted for development of an alternative payload that it maintains will only be used for testing--however, the Air Force holds it will not meet its requirements, and is not compatible with the Joint Service Imagery Processing System. The GAO concluded that, if not satisfactorily solved, this problem could undermine the program goals of having a common-Service vehicle, payload, and imagery processing systems for unmanned aerial vehicles and manned aircraft. (pp. 3-4, pp. 14-16/GAO Draft Report)

DoD RESPONSE: Partially Concur. While agreeing there is a fit problem with the Advanced Tactical Air Reconnaissance System- it is resolvable. It also should be understood that, even if the Advanced Tactical Air Reconnaissance System fit in the payload compartment of the Medium-Range Unmanned Aerial Vehicle, the program still would have had to be restructured. The fit problem has been worked since July 1989. The Unmanned Aerial Vehicle Program Office and the Advanced Tactical Air Reconnaissance System Program Office explored two possible solutions: (1) modify the payload or (2) modify the air vehicle. In October 1990, because of the fit problem and the other considerations (discussed in the DoD response to Finding D) the least cost solution was determined to be a modification to the air vehicle. Within that context, the cost is a relatively small part of the total cost of the restructure. To further improve coordination between the air vehicle and payload programs, a Memorandum of Understanding has been signed making the air vehicle program manager responsible for integrating the payload into the Medium-Range Unmanned Aerial Vehicle.

Amplification about the alternative payload is required to set the record straight. The test and evaluation payload was deemed necessary at the time of contract award with Teledyne Ryan Aeronautical in June 1989, because the Advanced Tactical Air Reconnaissance System payload would not be available in time for the scheduled air vehicle flight test. The intention was to conduct air vehicle

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See comment 2.

See comment 3.

See comment 4.

flying qualities and performance testing, while utilizing an off-the-shelf, low cost, test and evaluation payload. The payload was to be replaced with the Advanced Tactical Air Reconnaissance System payload when it became available. Because of Medium-Range program delays, the test and evaluation payload is no longer required for initial flight test. The program goals have always been a common-service vehicle, payload, and imagery processing system for both manned and unmanned systems. Those goals will be retained in any program restructure. As indicated, the payload fit problem has been solved by redesigning the air vehicle and the Unmanned Aerial Vehicle Executive Committee will review the restructured program to ensure a Service-unique system is not developed.

See comment 5

- **FINDING C: Air Force Failed To Coordinate With Unmanned Aerial Vehicle Program Office And Control Payload Size.** The GAO reported that, in February 1988, the Air Force provided the Program Office with Advanced Tactical Air Reconnaissance System specifications (which resulted in the eventually successful contractor increasing the size of its Unmanned Aerial Vehicle). The GAO found, however, that before the June 30, 1989 Unmanned Aerial Vehicle contract award, the subcontractor for the videotape recorder component of the Advanced Tactical Air Reconnaissance System revised those specifications with the knowledge and approval of the Air Force and its prime contractor. The GAO noted that, according to Air Force officials, the division of the recorder into two components (which were larger overall) was dictated by a military standard that requires equipment to be lifted by military personnel weigh no more than 37 pounds. The GAO reported that specifications for the revised payload were presented during a coordination meeting on July 27, 1989, at which time the Unmanned Aerial Vehicle officials learned that the Advanced Tactical Air Reconnaissance System would no longer fit in the Medium-Range Unmanned Aerial Vehicle payload bay. The GAO concluded that the fit problem stemmed from failure by the Air Force (1) to coordinate adequately with the Unmanned Aerial Vehicle Program Office and (2) to control the size of the Advanced Tactical Air Reconnaissance System payload during the development process. (p. 4, pp. 16-19/GAO Draft Report)

Now on pp. 2, 12-13

DoD RESPONSE: Partially Concur. The DoD agrees that, initially the Air Force did not coordinate adequately with the Unmanned Aerial Vehicle Program Office. The Air Force did coordinate with the Naval Air Systems Command on payload development for manned systems. The Navy, through its designated representative, was included in the Advanced Tactical Air Reconnaissance System request for proposal, source selection, program reviews, and design reviews. The Advanced Tactical Air Reconnaissance System contract was awarded in May 1988, a year before the Medium-Range system

See comment 6.

See comment 7.

See comment 5.

See comment 8.

contract award. Therefore, initial contacts with the Navy were established to work manned systems issues, and a learning curve developed for unmanned systems as the Unmanned Aerial Vehicle Program Office came on line. The payload fit problem for the Medium-Range air vehicle resulted from a recorder design change driven by integration flexibility and maintenance considerations for the manned aircraft. Developing a payload suitable for manned and unmanned vehicles, while satisfying the requirements of multiple Services, is a major challenge. The compromise reached to modify the Unmanned Aerial Vehicle was the most cost-effective solution for the Government. The fit problem has been resolved (as discussed in the DoD response to Finding A).

At a September 1988 Medium-Range bidders conference, preliminary payload information was provided. Formal information was provided to the Unmanned Aerial Vehicle Office in February 1989 not February 1988. That information was provided in response to a request for a detailed definition of the Advanced Tactical Air Reconnaissance System. The information was based on November 1988 preliminary design review data and included a statement that changes in the design could occur. The Advanced Tactical Air Reconnaissance System specification did not contain size and weight requirements for the Unmanned Aerial Vehicle components, other than the requirement to be less than 345 pounds and having to fit into a 20 by 100 inch cylinder.

• **FINDING D: Medium-Range Unmanned Aerial Vehicle Has Several Other Problems.** The GAO reported that the Medium-Range Unmanned Aerial Vehicle has encountered several other problems, as follows:

- **Material Structure Can Become Unsafe.** The GAO found that the airframe structure could deteriorate rapidly in a saltwater environment and allow delamination of the outer composite skin--which would be difficult to detect and unsafe for launching from manned aircraft.
- **Design Could Cause Crashes of Manned Aircraft.** The GAO found that, when launched from the F/A-18 aircraft, the Unmanned Aerial Vehicle design could cause it to lift and crash into the aircraft.
- **Ocean Recovery System is Inadequate.** The GAO found that the plan to recover the Unmanned Aerial Vehicle in the ocean raises to an unacceptable level the risk of water and corrosion damage to the Advanced Tactical Air Reconnaissance System.
- **Navigation System is Inadequate.** The GAO found that the Unmanned Aerial Vehicle navigation system has

insufficient accuracy for identifying the location of targets.

- System is Susceptible to Friendly Weapons. The GAO found that the planned identification-friend-or-foe system for the Medium-Range Unmanned Aerial Vehicle does not ensure that friendly forces could distinguish it from enemy aircraft.
- Cooling System May be Inadequate. The GAO found that the cooling system may be inadequate for the payload.
- Control Station is Too Large for Navy Aircraft Carriers. The GAO found that the configuration of Navy aircraft carriers allows no space for a manual control station for remotely piloted operation--meaning preprogrammed flight and recovery plans cannot be modified after launch, as required.

The GAO concluded that, to solve the identified problems the Program Manager is proposing that a virtually new Unmanned Aerial Vehicle be developed. The GAO observed that the new vehicle would include a larger payload bay and other features to solve the system's existing problems. (pp. 4-6, pp. 19-23/GAO Draft Report).

DoD RESPONSE: Partially Concur. The DoD concurs that the Medium-Range Unmanned Aerial Vehicle Program has encountered several problems, but does not always concur with the GAO explanations of those problems. The following comments on each problem are provided to improve the accuracy of the statements:

- Material Structure Can Become Unsafe. Not only is delamination of the outer composite skin difficult to detect, but it may be impossible to detect. If the composite skin is delaminated from the supporting honeycomb material, it may not be safe to carry on, as well as launch from, manned aircraft.
- Design Could Cause Crashes of Manned Aircraft. While design could be a problem, no conclusive data exists at this time. Wind tunnel tests scheduled for February 1991 should either confirm or reject whether it is a problem--and if so, to what extent.
- Ocean Recovery System is Inadequate. Whether ocean recovery actually causes an unacceptable level of risk because of water and corrosion damage to the payload has not been determined. The Medium-Range Unmanned Aerial Vehicle utilizes a parachute descent to the ground or ocean for flight termination. If the air vehicle is damaged during water impact, water intrusion could cause damage/corrosion to the Advanced

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See comment 9

See comment 10

See comment 11.

Tactical Air Reconnaissance System payload. The planned flight test program will determine the level of risk associated with water landing. A Mid-Air Retrieval System, which utilizes an HH-60 helicopter to catch the descending parachute (with the underslung Unmanned Aerial Vehicle) has been successfully demonstrated and is the preferred Navy solution. It is anticipated that that system will be the primary means for over-water recovery.

See comment 12.

- Navigation System is Inadequate. The DoD does not agree that the navigation system has inadequate accuracy for identifying targets, as the GAO asserts. The navigation system of the air vehicle is made up of three subcomponents that, together, provide the required degree of accuracy for identifying targets. The GAO incorrectly implies that the air vehicle navigation system is dependent solely on the commercial Global Positioning System to achieve the required accuracy. The Unmanned Aerial Vehicle navigation system may not provide sufficient navigation accuracy during limited periods of time when the Federal Aviation Agency may elect to degrade the commercial signals of the Global Positioning System. That potential problem can, however, be overcome by replacing the commercial receiver with a militarized (encrypted) Global Positioning System receiver. The decision to incorporate the more expensive (off-the-shelf) militarized receiver would be made prior to Operational Test and Evaluation, and would be based on the prevailing Federal Aviation Agency policy.

See comment 13.

- System is Susceptible to Friendly Weapons. The problem of susceptibility to friendly weapons is not unique to unmanned vehicles, but is also shared by manned aircraft. The potential deficiency was discovered during a computer simulation wargame. As a result, the Medium-Range air vehicle will have an off-the-shelf militarized Identification-Friend-or-Foe system that incorporates Mode 4 capability similar to manned aircraft. The additional system will provide the most effective identification method currently available.

See comment 14

- Cooling System May be Inadequate. During some hot day, low level, high speed imaging flights on which data is simultaneously recorded and downlinked, it is possible that the cooling capability of the Unmanned Aerial Vehicle may be exceeded if the fuel load is low. That condition, however, is a very unlikely operational scenario, because the downlink line-of-sight range is very limited at low altitude. Although simultaneous recording and downlinking is not an

operational requirement, those conditions will be evaluated during testing. If a deficiency is indicated, either hardware or operational limitation changes will be incorporated.

See comment 15

- Control Station Is Too Large for Navy Aircraft Carriers. DoD does not agree with the GAO assessment that the control station is too large for Navy aircraft carriers. The problem is with the space that can be allotted on aircraft carriers for Unmanned Aerial Vehicle operations. Currently, because of other higher priority equipment the available space is too small to accommodate the Local Control Monitor Station. The requirement for a Local Control Monitor Station primarily was intended to provide a remotely piloted capability for use with ship launched non carrier operations, while the air launched preprogrammed capability was intended to support carrier operations. It is anticipated that the remotely piloted requirement for carriers will be deleted.

See comment 16

The term "virtually new unmanned air vehicle" is inaccurate. It implies no benefit has been obtained from work to date. That is not the case. For amplification, the Program Manager is proposing several programmatic changes. They include (1) directing the contractor to implement an all metallic primary structure air vehicle containing a payload compartment large enough to accommodate the Advanced Tactical Air Reconnaissance System payload, (2) realigning integration responsibilities, and (3) completing all wind tunnel separation testing prior to Government approval of the air vehicle design.

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RECOMMENDATIONS

- RECOMMENDATION 1: The GAO recommended that the Secretary of Defense assure that the solution to the payload fit problem preserves the commonality goals of the Medium-Range Unmanned Aerial Vehicle, the Advance Tactical Air Reconnaissance System, and the Joint Service Imagery Processing System programs. (p. 6/GAO Draft Report)

Now on p. 4

DoD RESPONSE Concur. The recommendation is moot, however, the DoD has already implemented preserving commonality by the proposed redefinition of the Medium-Range program; which increases the payload compartment size to carry the Advanced Tactical Air Reconnaissance System and deletes the test and evaluation payload. The Unmanned Aerial Vehicle

Executive Committee will oversee the restructuring of the Medium-Range program and will ensure commonality goals are maintained.

- **RECOMMENDATION 2:** The GAO recommended that the Secretary of Defense require the Services to obtain advance written concurrence for changes for separately developed interrelated programs to assure integration problems (such as experienced by the Medium-Range Unmanned Aerial Vehicle/Advanced Tactical Air Reconnaissance System fit situation) do not occur in future programs. (p. 6/GAO Draft Report)

Now on p. 4.

See comment 17

DoD RESPONSE: Nonconcur. The DoD already has a mechanism in the acquisition process to ensure changes in a subsystem in one program are coordinated with other related programs. It is done through configuration control boards, which are an internal part of the DoD acquisition system. Accordingly, the DoD does not need another procedure. In the case of Unmanned Aerial Vehicles, due to the newness of the Joint Program Office, those procedures were not implemented as early as they might have been. The Joint Program Office currently is in the process of establishing configuration control policies and procedures to address just those types of issues. The configuration control policies and procedures are expected to be coordinated and in place by 1 April 1991.

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MATTER FOR CONGRESSIONAL CONSIDERATION

- **SUGGESTION:** The GAO suggested that the Congress monitor closely the Department's efforts to solve the problem and oppose any funding requests which do not preserve commonality goals. (The GAO asserted that the opportunity to achieve a common-Service unmanned aerial vehicle, a common-Service payload for use on both unmanned aerial vehicles and manned aircraft, and a common-Service imagery processing system for unmanned aerial vehicles, manned aircraft and national assets could all be lost if the Department of Defense does not satisfactorily resolve the fit problem) (p. 7/GAO Draft Report)

Now on p. 4.

DoD RESPONSE: Concur. As previously indicated, the payload fit problem has been resolved. The DoD remains committed to the goals of interoperability and commonality.

The following are GAO's comments on the Department of Defense's letter dated February 12, 1991, and its accompanying enclosure.

GAO Comments

1. We have revised our report to reflect DOD's higher revised cost estimate and the additional factors causing the increase.
2. We recognize that the cost of the proposed solution to the fit problem is relatively small compared to the total restructure cost. However, because the impact of not satisfactorily solving this problem would be serious, and because of the amount of DOD and contractor time and energy it has absorbed, the relative cost cannot diminish the significance of the problem or the affect it has had on the UAV program.
3. While the Memorandum of Understanding may improve coordination between the two programs, it will not prevent future recurrence of problems such as the fit problem because the air vehicle program manager has no influence over the size of the payload. (See also comment 17.)
4. Our report recognizes the Navy's contention that the alternative payload will only be used for testing. Even though DOD's comments indicate that the alternative payload will no longer be needed for initial flight testing, we note that its development is still under contract.
5. The UAV Executive Committee had not yet approved a restructured UAV program, which includes the proposed solution to the fit problem, when we completed our work.
6. The adequacy of coordination for manned aircraft systems was not the subject of our review. Our review focused on the lack of adequate coordination on the unmanned program.
7. We agree that the recorder design change was driven by manned aircraft considerations. However, the change was made without coordinating with the Medium-Range UAV Program Office. If this coordination had occurred at the time the decision was made to change the ATARS design, the UAV fit problem could have been avoided. DOD's recognition that developing a payload for manned and unmanned vehicles is a "major challenge" strongly indicates why the Air Force should have ensured coordination of the change in the size of the payload.

8. We modified our report to clarify the chronology of events leading up to the July 27, 1989, discovery that the payload would not fit in the UAV. We understand that the initial payload information provided by the Air Force was preliminary and could change. We continue to believe, however, that the Air Force should have informed UAV program officials before, not after, the changes were approved. If the UAV Program Office had been a party to the decision to change the payload size, the creation of the fit problem may have been avoided.

9. We modified our report to reflect the additional information provided by DOD.

10. We agree that tests should be done to determine whether this is a problem. The Medium-Range Program Manager's analysis suggests that it is a problem.

11. Although the UAV Program Office did not make a formal determination on whether the level of risk associated with water landings is unacceptable, the Navy's "preferred solution" of having a helicopter catch a UAV in mid-air rather than allowing the UAV to be exposed to potential water damage is tantamount to acknowledging that the risks of ocean recovery are unacceptable. However, we revised our report text to address DOD's comments.

12. We did not mean to imply that the air vehicle navigation system is dependent solely on the commercial version of the Global Positioning System. Our report focuses only on the commercial system because UAV program officials said that it might need to be replaced with a more expensive military version of the Global Positioning System to provide the accuracy necessary to identify the location of targets. As DOD indicated, the decision to overcome the potential navigation problems by incorporating the military version has not yet been made.

13. Our report deals only with the Medium-Range UAV problems, not those of manned aircraft. The problem as described in our report resulted from the planned use of the identification system for commercial aircraft. DOD determined this system to be inadequate and now plans to use the military system referred to as Mode 4.

14. We modified our report to reflect DOD's judgment that the conditions likely to create an overheating problem were not likely to occur. We also noted that the Program Manager has proposed a design change that will reduce the risk of overheating.

15. The control station may be considered too large for the space available on aircraft carriers or the aircraft carrier space to be too small for the control station. Regardless of how it is presented, the space problem exists and, as a result, DOD anticipates that the remote piloting feature will be dropped.

16. We now refer to the proposed UAV as a vastly different UAV in our report rather than a "virtually new UAV."

17. Air Force configuration control board procedures require written recommendations of approval or disapproval of proposed changes by control board members. However, neither DOD nor Air Force procedures specifically identify required membership on the board. Clearly, DOD's configuration control board procedures did not ensure that the ATARS payload would fit in the UAV. The Medium-Range UAV Program Manager was not a member of the configuration control board for ATARS, although the Medium-Range UAV and ATARS are interdependent programs. Despite the ATARS fit problem, the Medium-Range Program Manager or his designated representative is still not a member of the ATARS configuration control board. Thus, there is no DOD procedure to preclude problems such as the Air Force unilaterally increasing the size of the payload.

The Secretary of Defense could implement our recommendation by changing configuration control board procedures to specifically require that program managers of interrelated programs or their designees be represented on configuration control boards.

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